

## SECTION I.—AEROLOGY.

## THE TOTAL RADIATION RECEIVED ON A HORIZONTAL SURFACE FROM THE SUN AND SKY AT WASHINGTON, D. C.

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*Apparatus.*—The reader is referred to this REVIEW for August, 1914, 42:474-487, for a description of the Callendar pyrheliometer, the method by which it has been standardized, and a summary of the radiation measurements obtained by means of it at Mount Weather, Va., between May, 1912, and September, 1914.

*Exposure.*—In Table 1 of this paper are summarized in a similar manner measurements obtained at the Central Office of the Weather Bureau, Washington, D. C., between July, 1909, and April, 1912. Callendar pyrheliometer No. 7016 was employed in making the measurements. It was exposed on the top of a 50-foot tower erected on the roof of one of the Weather Bureau buildings, and recorded by a Callendar self-adjusting Wheatstone bridge. The pyrheliometer was about 150 feet (46 meters) above sea level. It had practically unobstructed exposure to the sky in all directions down to the true horizon. This pyrheliometer is similar to those described and illustrated in the REVIEW for August, 1914, above referred to, except that it consists of two platinum grids instead of four, and in consequence the blackened and the bright grids each occupy one side of a square instead of diagonally opposite corners of it.

The records were made on 75th meridian time, and the third column of Table 1 shows how many minutes the register clock was faster than the sun.

*Reduction of records.*—Pyrheliometer No. 7016 has not been subjected to the rigorous tests applied to No. 13129, with which the Mount Weather records were obtained. The radiation equivalent of tenth of an inch spaces on the record sheets,<sup>1</sup> as derived from the Callendar certificates for these two instruments, with No. 13129 recording on a Leeds & Northrup register, is in each case 0.0247. The reduction factors given in Table 8 of the REVIEW for August, 1914,<sup>2</sup> have therefore been employed in reducing to heat units the records from Callendar pyrheliometer No. 7016, summarized below in Table 1.

At the end of September, 1914, Callendar pyrheliometer No. 13129 was removed from Mount Weather, and installed on the top of a ventilating flue of the College of History Building, American University, Washington, D. C.<sup>3</sup> It is about 451 feet (137 meters) above sea level, and there is practically no obstruction between it and the sky in any direction down to the true horizon. It records on the same Leeds & Northrup register that was employed at Mount Weather; and its records have been reduced to heat units by the use of the factors there determined. The records are summarized in Table 2. The register clock is set to keep apparent or true solar time.

There is some evidence that with the present installation of pyrheliometer No. 13129 internal reflection from the glass cover causes it to record relatively too little

radiation when the sun is near the horizon.<sup>4</sup> The data of Table 2 may, therefore, require a slight correction, the amount of which will be determined after a longer series of observations has been obtained.

*Daily extremes.*—In Table 3, columns 5 and 6, are given the maximum and the minimum daily amounts of solar and sky radiation that have been recorded at Washington in the consecutive decades covered by the records. In figure 1, trace I (○), are plotted the absolute daily maxima for each decade throughout the year, as derived from Table 3, column 5. These maxima represent the daily amounts of radiation received in each decade when the sky is clearest. Figure 1, trace I, is therefore the curve of annual variation in the possible daily radiation for Washington, and the "Percentage of possible radiation" given in Tables 1 and 2 has been obtained by dividing the "Daily average" for each decade by the possible daily radiation for the corresponding decade, as derived from this trace.

The percentage of possible sunshine has been obtained from the record of sunshine by the Marvin sunshine recorder installed at the central office of the Weather Bureau, and the mean daily cloudiness from the eye estimates of cloudiness entered in the Daily Meteorological Record for the Washington station.

*Maximum solar radiation at normal incidence.*—In figure 2, trace I (+) represents the monthly maxima of solar radiation intensities at normal incidence at Washington. It is based on measurements made at the central office of the Weather Bureau between December, 1905, and February, 1912, and at the American University from October, 1914, to date. These maxima have usually occurred shortly before noon.

It is to be noted that while a maximum of 1.50 calories per minute per square centimeter of area has been recorded in February there is but little variation in the monthly maxima from November to April, inclusive. The lowest monthly maximum, 1.40 calories, has been recorded in June and August. These maxima exceed those for Mount Weather for the cold months November to February, inclusive, and are below those for Mount Weather from May to October, inclusive.<sup>5</sup> The lower maxima at Washington during the summer months are to be attributed to the accumulation of dust and moisture in the lower layers of the atmosphere at this season of the year. As already explained in connection with the Mount Weather data, the high solar radiation intensities of winter, with the sun more than 60° from the zenith, as compared with the intensities in summer with the sun less than 20° from the zenith, are to be attributed to the small amount of dust and moisture in the atmosphere in winter, and the relative nearness of the earth to the sun at that season.

<sup>1</sup> MONTHLY WEATHER REVIEW, August, 1914, 42: 477, fig. 5.<sup>2</sup> MONTHLY WEATHER REVIEW, August, 1914, 42: 480.<sup>3</sup> MONTHLY WEATHER REVIEW, December, 1914, 42: 648.<sup>4</sup> Mr. Eric R. Miller has called my attention to the fact that in this REVIEW, August, 1914, 42:478-9, the effect of internal reflection from a hemispherical glass envelope is not given proper consideration.<sup>5</sup> MONTHLY WEATHER REVIEW, August, 1914, 42:484-5.

The reason for the relatively low monthly maxima at Mount Weather during the winter is not apparent.

*Maximum solar and sky radiation on a horizontal surface.*—In Table 3, columns 3 and 4, are given the maximum radiation per minute, and the maximum recorded in any one hour by the Callendar recorder, in the successive decades. The hourly maximum is recorded in the hour just preceding or following noon on a clear day. The maximum rate per minute usually occurs when clouds surround the sun, but do not obscure it.

The absolute decade maxima of columns 3 and 4, respectively, have been plotted in figure 2 as traces II (○) and III (●), the hourly rates of column 4 having first been reduced to minute rates. As was explained in connection with similar curves for Mount Weather,<sup>6</sup> trace II exceeds trace III principally because of heat reflection

On account of the short period during which records were obtained at each of these stations, the means as computed above have been smoothed by the equation  $m = \frac{1}{3}(a+b+c)$ , where  $b$  is the mean for the decade for which the smoothed mean,  $m$ , is to be computed, and  $a$  and  $c$  are the means for the preceding and following decades, respectively. In this way means have been computed for 36 overlapping monthly periods throughout the year, commencing with the 1st, 11th, and 21st of the consecutive months. The smoothed means thus determined for the daily amounts of radiation have been plotted in figure 1, trace II, the crosses (+) representing the data for Washington, and the filled circles (●) the corresponding data for Mount Weather. It will be noted that there is close agreement between these data during the first half of the year, but that the Washington

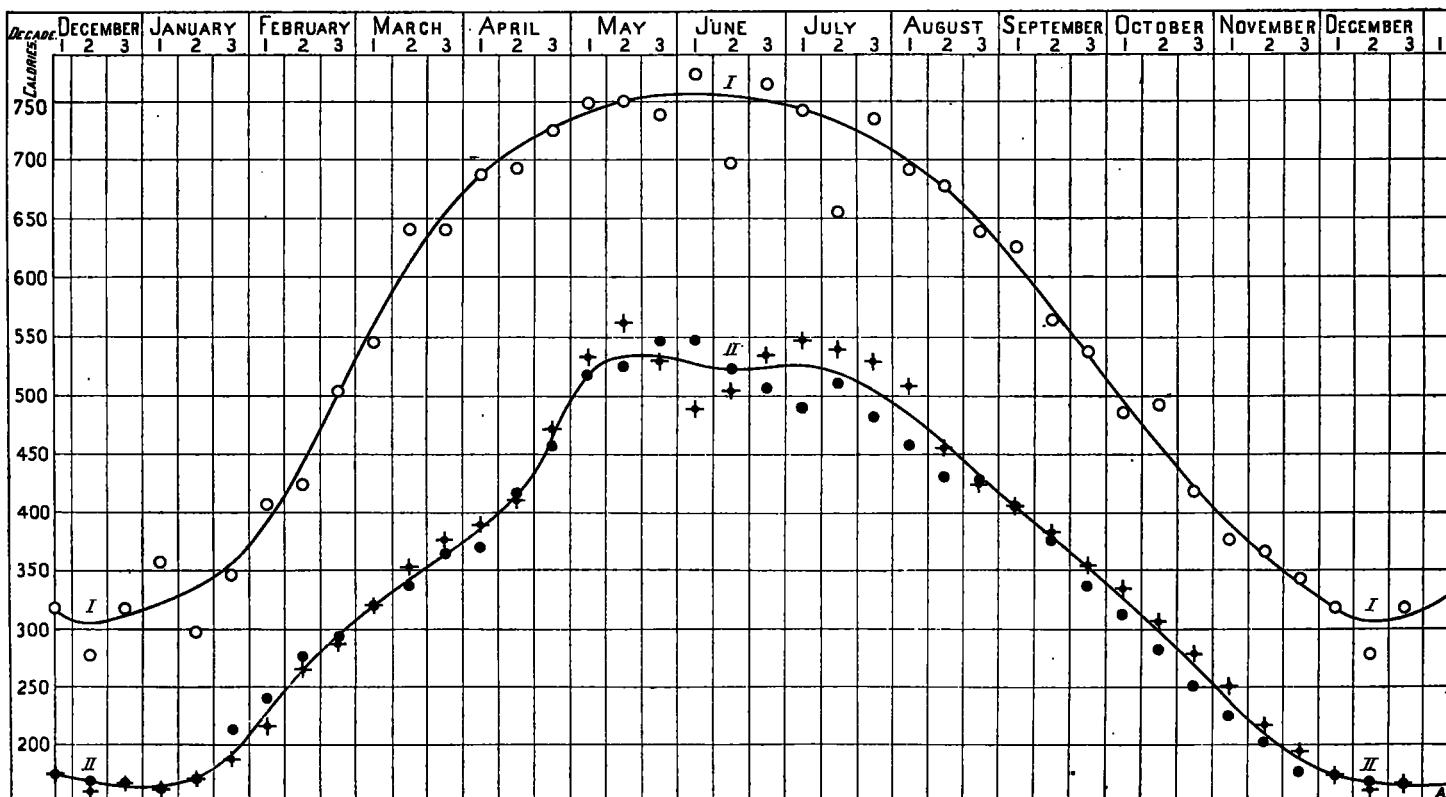


FIG. 1.—Maximum and mean daily amounts of solar and sky radiation in gram-calories per square centimeter of horizontal surface. I (○), maximum for Washington, D. C.; II (+), mean for Washington, D. C.; III (●), mean for Mount Weather, Va.

from cloud surfaces. The increase from this source in the maximum rates of radiation received on a horizontal surface averages about 0.15 calorie per minute.

*Decade means.*—The decade averages of solar and sky radiation for each hour of the day as given in Table 1 have been plotted with 75th meridian time as abscissæ and the hourly amounts of radiation as ordinates. The hour lines for each decade were then shifted by the number of minutes that Table 1, column 3, shows are necessary to obtain apparent time, and the amounts of radiation corresponding to these new hour lines were read off.

From the decade averages thus determined, together with those of Table 2, mean values of the hourly and daily solar and sky radiation for Washington for each decade throughout the year have been computed. Similar means have also been computed for Mount Weather from the decade averages given in the REVIEW for August, 1914, 42:482, Table 9.

data is generally the higher by a few per cent during the last half of the year.

In the data for both stations there is evidence of a maximum of radiation in May, and of a secondary minimum in June or July, followed by a secondary maximum.

*Daily normals and departures of solar and sky radiation.*—In drawing figure 1, trace II, consideration was given to the data for both Washington and Mount Weather; and it is probable that this trace represents the annual variation in the daily amounts of radiation received at each station better than would separate curves based on the data for the respective stations.

In Table 4, column 2, are given the daily normals of radiation for Washington and Mount Weather as read off from figure 1, trace II. In the following columns are given the daily departures from these normals, and the "Total excess or deficiency since the first of the month." In the footings are also given these totals from the first of the year.

*Daily totals of radiation.*—The algebraic sum of the daily normal and daily departure will give the daily amount of radiation as measured. The daily departures, and the total excess or deficiency of radiation since the first of the month or since the first of the year, respectively, contain whatever errors there may be in the normals. They should be used with caution, therefore, especially when comparing data obtained at the two stations. They probably show the time of occurrence of periods of excess or deficiency of radiation, without accurately measuring the amount of this excess or deficiency.

When the record for a part or the whole of a day is missing, it has seemed better to supply it from records for other days having the same amount of sunshine, rather than to leave it blank. The days on which data have been supplied in this way are indicated in Table 4 by appropriate reference marks.

The lines of zero radiation have been determined from the average time of sunrise and sunset given in Table 1, column 2, for each decade.

These isopleths of radiation may be compared with the thermo-isopleths for Washington prepared by Cleveland Abbe, jr., and reproduced in figure 1, page 113, of this REVIEW. It is significant that the monthly mean diurnal range of temperature for Washington reaches a maximum of 20.2°F. in May, at the time the diurnal solar and sky radiation reaches its maximum, and a minimum of 15.4°F. in December, at the time the diurnal radiation reaches its minimum. The times of occurrence of the seasonal maximum and minimum temperatures are, of course, retarded as compared with the times of occurrence of the maximum and the minimum daily amounts of radiation, just as the maximum temperature for the day occurs not at noon, the time when the radiation is at its maximum, but some hours after noon.

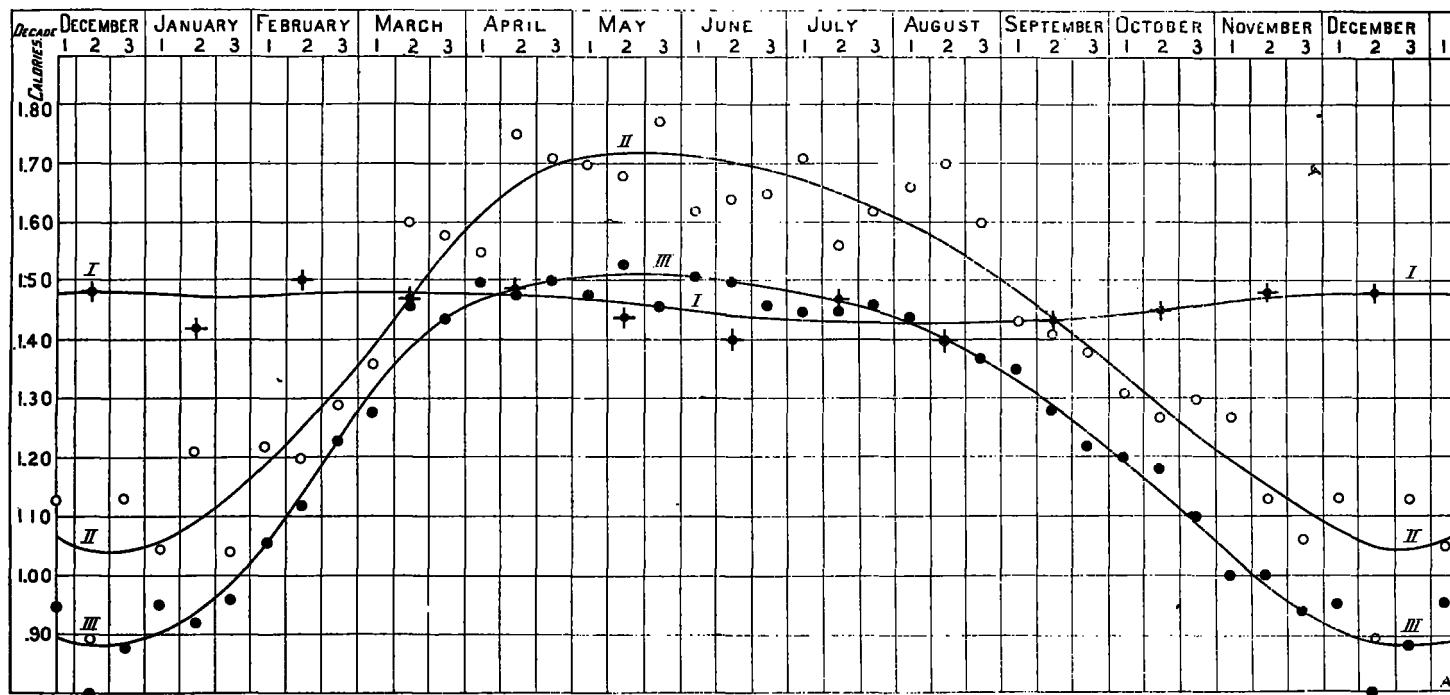


FIG. 2.—Maximum radiation per minute in gram-calories per square centimeter at Washington, D. C. I (+), solar radiation at normal incidence; II (O), solar and sky radiation on a horizontal surface, with clouds near the sun but not obscuring it; III (●), solar and sky radiation on a horizontal surface, with cloudless sky.

*Isopleths of solar and sky radiation.*—The smoothed decade means of solar and sky radiation for Washington for different hours of the day were plotted with apparent time as abscissas and the decades as ordinates. For the months of May and June, with data for only two years available, the decade means were so irregular that they were still further smoothed by combining them with the decade means for Mount Weather, giving each equal weight. It will be noted from figure 1, trace II, that during the six decades of these two months the decade means of daily radiation for Washington were higher than those for Mount Weather on three decades and lower on three decades. Isopleths of solar and sky radiation thus determined are reproduced in figure 3, the lines for the months of May and June being broken to indicate that they are not so well determined as those for other months. The isopleths show a maximum of radiation in May, a secondary maximum in July, and a secondary minimum between them, all of which persist practically from sunrise to sunset.

#### SUMMARY.

The Callendar records of solar and sky radiation obtained at Washington show slightly higher daily totals on clear days than do the corresponding records for Mount Weather. Trace II, figure 1, shows that the mean daily amounts are nearly the same at the two stations during the first half of the year, but that the Washington means are slightly higher during the second half of the year.

Trace I, figure 1, shows that the daily totals for Washington on clear days are higher during the first half of the year than during the second half, as was the case at Mount Weather, and that the maximum occurs early in June.

Although the mean daily radiation for Washington reaches a maximum in May, as shown by Trace II, figure 1, it averages higher during the second half of the year than during the first half, on account of the greater average cloudiness during the spring months than during the fall months.

The isopleths of solar and sky radiation, figure 3, give a graphic picture of the rates at which heat energy is received from the sun and sky throughout the year. Since the heat energy thus received is not only the cause of both the seasonal and the diurnal temperature varia-

tions, but also of all atmospheric movements, and consequently of all weather changes, the data here presented should be of special value to meteorologists and biologists.

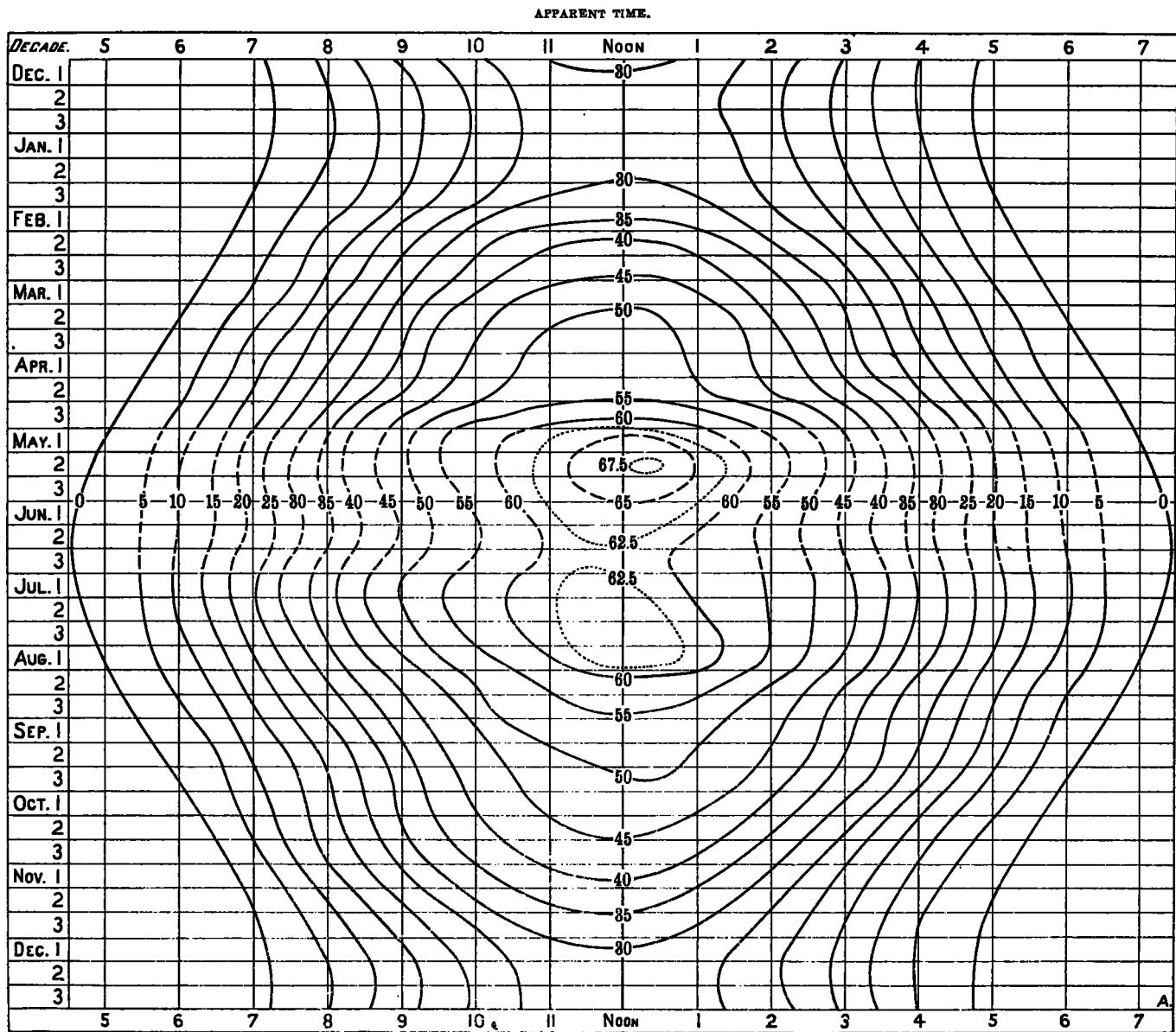


FIG. 3.—Isopleths of solar and sky radiation for Washington, D. C. (Gram-calories per hour per square centimeter of horizontal surface.)

## MONTHLY WEATHER REVIEW.

MARCH, 1915

TABLE 1.—*Solar and sky radiation, expressed in gram-calories per square centimeter of horizontal surface, at Washington, D. C.*  
 [Central Office of the Weather Bureau, Lat. 38° 54' N.; long. 77° 03' W. Altitude, 46 meters.]

Decade.	Mean solar h. a. at sunrise and sunset.	Register clock faster than sun.	Decade average during hours ending (seventy-fifth meridian time)—																Daily average.	Per cent of pos- sible radiation.	Per cent of pos- sible sunshine.	Mean daily cloudiness.		
			A. M.								P. M.													
			5	6	7	8	9	10	11	Noon.	1	2	3	4	5	6	7	8						
			H. m.	Mm.	Gr.-c.	Gr.-c.	0-10																	
July 24-31.....	7 11	+14	11.0	26.4	40.9	56.8	70.1	77.4	57.6	50.9	38.3	33.8	17.7	5.6	0.4	554	77	74	74	4				
Aug. 1-10.....	7 01	21	9.4	20.7	34.0	47.6	57.3	65.8	69.0	64.8	44.6	28.2	15.8	4.5	0.1	518	74	52	36	7				
11-20.....	6 51	12	0.7	5.9	17.0	26.8	31.3	34.1	42.1	45.0	43.3	35.4	31.5	22.0	11.4	3.1	349	52	52	32	2			
Sept. 21-31.....	6 30	9	1.4	11.7	24.8	43.4	52.8	61.9	69.9	68.5	58.7	52.6	41.1	28.4	12.6	1.8	530	52	68	52	6			
Oct. 1-10.....	6 28	7	0.3	5.4	14.6	26.4	35.3	44.4	51.2	52.5	56.8	50.3	38.6	25.8	10.2	1.7	417	68	52	40	5			
11-20.....	6 13	3	0.1	4.9	15.0	22.9	29.2	35.2	40.8	49.6	47.7	43.2	32.3	17.2	5.1	0.1	343	60	40	30	6			
21-30.....	6 01	0	-	4.8	14.7	27.7	41.0	47.1	56.0	56.4	52.6	37.6	30.3	16.2	4.2	0.1	389	73	53	50	5			
Nov. 1-10.....	5 48	-3	-	2.8	18.6	24.4	37.6	43.2	45.4	48.6	45.4	36.7	32.0	17.4	5.1	0.1	340	69	71	73	3			
11-20.....	5 36	-8	-	1.4	11.3	22.4	34.1	40.7	44.5	42.0	37.2	27.7	17.4	6.5	0.7	0.1	286	63	51	55	5			
21-31.....	5 23	-7	0.9	8.4	19.1	31.9	34.8	43.7	45.6	38.7	27.5	15.4	3.6	0.1	0.1	270	64	63	55	5				
Dec. 1-10.....	5 01	21	0.1	5.6	15.0	24.4	32.3	36.0	39.4	32.2	20.3	13.1	3.0	0.1	0.1	221	57	53	53	5				
11-20.....	4 92	-7	-	3.3	10.4	19.2	28.7	35.0	34.9	32.8	25.6	13.4	2.5	0.1	0.1	206	57	72	33	3				
21-30.....	4 52	-4	-	3.2	11.5	17.7	27.4	31.5	33.6	28.3	22.2	9.9	1.1	0.1	0.1	188	56	75	44	4				
Dec. 1-10.....	4 47	-1	1	1.5	11.2	21.2	28.4	32.9	33.5	30.6	23.2	10.0	0.9	0.1	0.1	192	61	88	33	3				
11-20.....	4 33	-4	-	0.2	8.6	11.9	21.0	27.0	25.1	20.9	15.4	4.9	0.2	0.1	0.1	133	44	55	55	5				
21-31.....	4 43	8	-	0.9	7.4	17.0	27.0	32.7	36.5	30.6	21.9	11.5	2.6	0.1	0.1	189	61	65	65	5				
1910.																								
Jan. 1-10.....	4 46	14	-	-	0.5	6.4	14.9	25.4	29.1	28.3	24.8	19.1	11.4	2.7	0.1	0.1	163	51	56	56	6			
11-20.....	4 52	18	-	-	0.9	15.4	21.5	25.5	28.4	26.2	20.0	11.3	2.5	0.1	0.1	158	47	56	40	5				
21-31.....	5 01	21	-	-	0.5	4.4	12.1	19.6	19.4	20.4	18.3	15.6	10.6	3.8	0.1	0.1	125	35	28	8	8			
Feb. 1-10.....	5 12	22	-	-	2.2	11.7	22.9	35.6	42.8	46.3	40.5	30.6	19.5	7.1	0.7	0.1	280	67	71	44	4			
11-20.....	5 23	22	-	-	3.8	15.3	28.2	36.8	41.8	43.9	39.8	30.6	18.2	7.2	0.6	0.1	266	60	67	5	5			
Mar. 1-10.....	5 46	20	-	-	0.4	5.9	14.9	26.1	34.0	40.7	39.9	36.4	20.0	10.9	2.7	0.1	0.1	233	50	59	59	5		
11-20.....	5 59	17	-	-	2.3	11.2	24.6	31.4	51.3	50.0	52.1	50.0	41.4	25.3	14.0	3.7	0.8	0.1	361	55	55	55	5	
21-31.....	6 12	14	-	-	0.2	5.4	16.4	28.6	30.0	49.0	51.8	52.8	41.8	30.9	18.8	7.5	1.2	0.1	396	58	64	64	5	
Apr. 1-10.....	6 25	11	-	-	0.6	6.3	18.6	31.9	42.5	46.8	47.6	52.9	50.5	44.8	34.4	19.7	8.7	1.3	0.1	407	57	60	60	4
11-20.....	6 37	8	-	-	1.0	6.0	14.8	20.7	24.2	26.0	20.4	18.3	15.6	10.6	3.8	0.1	0.1	457	63	64	64	5		
May 1-10.....	6 49	6	-	-	1.0	9.5	22.6	42.8	53.4	55.1	60.6	59.5	47.4	29.2	20.8	10.6	2.2	0.1	529	71	70	70	4	
11-20.....	7 00	5	-	-	1.6	10.5	25.5	38.4	50.3	56.0	61.5	60.6	59.7	46.5	32.1	17.0	3.9	0.1	529	71	70	70	4	
21-31.....	7 10	4	-	-	2.6	14.1	30.9	41.2	52.5	67.2	62.8	53.4	48.6	39.5	28.3	18.1	4.6	0.2	515	69	71	55	5	
June 1-10.....	7 18	5	-	-	3.6	14.3	27.8	40.7	51.0	55.8	62.1	61.7	61.4	47.7	30.1	22.5	14.3	1.7	0.5	510	68	63	63	6
11-20.....	7 24	6	-	-	2.5	11.0	21.8	33.0	37.6	42.8	50.2	48.1	41.1	34.8	26.6	16.1	5.4	0.8	416	56	44	44	6	
21-30.....	7 27	8	-	-	1.3	6.0	12.5	23.1	31.1	39.2	47.9	50.1	47.2	37.4	25.9	15.4	5.3	0.4	379	50	42	7	7	
July 1-10.....	7 24	12	0.2	0.2	5.0	18.0	33.8	47.8	60.9	65.5	68.5	65.8	62.4	41.2	28.4	18.4	2.1	0.1	616	82	53	53	3	
11-20.....	7 19	14	-	-	2.7	10.5	25.7	40.8	49.6	51.3	51.7	47.9	49.2	44.7	36.3	27.0	13.9	6.4	0.4	458	62	46	46	4
21-31.....	7 11	14	-	-	3.0	14.8	30.3	44.4	58.7	67.0	71.5	74.9	71.2	59.8	48.0	35.0	21.4	8.3	0.5	609	85	70	70	2
Aug. 1-10.....	7 01	14	-	-	1.2	9.9	22.4	37.7	48.5	51.6	55.0	62.5	60.4	54.0	47.0	29.2	17.4	5.1	0.1	503	72	40	40	4
11-20.....	6 51	12	-	-	0.5	7.0	19.0	26.5	35.6	37.9	48.4	52.3	54.4	43.0	31.1	24.6	14.0	2.9	0.7	398	59	41	41	7
21-31.....	6 39	9	-	-	0.4	5.9	15.7	24.9	41.4	42.2	44.2	45.3	40.4	26.5	20.0	9.7	1.7	0.1	0.1	355	55	46	46	6
Sept. 1-10.....	6 26	7	-	-	0.2	5.3	17.0	29.5	38.7	40.0	50.8	52.0	42.0	35.3	30.3	20.2	7.8	1.3	0.1	380	62	58	58	4
11-20.....	6 48	-3	-	-	3.0	14.9	28.8	39.6	46.3	49.3	48.6	43.3	34.1	25.5	12.0	2.4	0.1	0.1	345	70	61	61	4	
21-31.....	5 36	-8	-	-	1.6	12.1	26.5	38.5	48.1	52.1	49.6	44.9	37.6	28.6	12.2	2.4	0.1	0.1	350	77	79	79	6	
Nov. 1-10.....	5 11	-7	-	-	0.5	7.0	19.9	31.1	38.9	40.0	37.1	29.0	21.8	12.2	3.7	0.2	0.1	305	72	57	57	5		
11-20.....	5 01	-7	-	-	0.1	4.9	15.6	27.8	37.1	41.0	36.7	26.3	21.3	10.7	1.8	0.1	0.1	241	62	52	52	5		
21-30.....	4 92	-4	-	-	2.3	11.8	21.9	30.1	32.7	32.7	28.4	21.7	17.7	9.5	1.5	0.1	0.1	191	57	55	55	5		
Dec. 1-10.....	4 47	-1	-	-	1.5	9.0	19.4	27.4	32.4	30.0	25.7	18.2	8.7	1.5	0.1	0.1	175	55	51	51	5			
11-20.....	4 43	4	-	-	1.5	9.0	19.4	27.4	32.4	30.0	25.7	18.2	10.2	2.1	0.1	0.1	188	62	46	46	5			
21-31.....	4 43	8	-	-	1.4	8.9	17.2	23.4	28.1	30.7	21.5	12.5	3.0	0.1	0.1	175	56	43	43	7				
1911.																								
Jan. 1-10.....	4 46	14	-	-	1.4	10.2	21.5	25.4	33.6	33.8	27.7	22.6	14.5	5.7	0.1	0.1	196	61	54	54	5			
11-20.....	4 52	18	-	-	1.0	5.7	13.3	22.7	25.1	26.4	25.4	22.4	16.1	6.0	0.6	0.1	165	49	22	22	6			
21-31.....	5 01	21	-	-	1.7	10.7	20.3	28.7	33.4	36.4	34.5	27.3	19.3	9.1	0.9	0.1	211	54	46	46	6			
Feb. 1-10.....	5 12	22	-	-	0.3	4.0	11.0	18.2	24.5</															

TABLE 2.—*Solar and sky radiation, expressed in gram-calories per square centimeter of horizontal surface, at Washington, D. C.*

[American University, District of Columbia, Lat. 38° 56' W., Long. 77° 05' N. Altitude, 137 meters.]

Decade.	Mean solar h. a. at sunrise and sunset.	Decade average during hours ending (apparent time)—																		Daily average.	Percent of possi- ble radiation.	Percent of possi- ble sunshine.	Mean daily cloud- iness.			
		A. M.									P. M.															
		5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8									
1914.	H. m.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	Gr.-c.	275	71	86	0-10				
Nov. 1-10.....	5 11	0.2	3.5	16.4	31.9	40.9	45.2	45.5	40.9	30.4	15.3	4.2	0.6	.....	.....	.....	.....	196	54	60	5					
11-20.....	5 01	2.2	10.6	21.7	28.5	34.8	31.0	29.0	22.4	12.6	3.3	0.3	.....	.....	.....	.....	195	58	57	6						
21-31.....	4 52	1.9	11.5	21.9	29.4	33.8	28.3	21.2	11.5	2.3	0.1	.....	.....	.....	.....	77	24	8	10							
Dec. 1-10.....	4 47	0.5	3.2	7.5	11.7	12.8	15.3	11.8	8.5	4.6	0.9	.....	.....	.....	.....	159	52	58	5							
11-20.....	4 43	1.3	9.1	19.0	24.6	28.1	26.9	23.6	17.1	7.2	1.6	.....	.....	.....	.....	142	46	44	7							
21-31.....	4 43	1.1	7.3	14.6	19.6	23.1	26.9	24.0	16.3	7.4	1.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....					
1915.																										
Jan. 1-10.....	4 46	1.4	9.6	10.8	29.5	34.7	33.0	31.1	21.3	8.7	1.4	.....	.....	.....	.....	190	59	75	3							
11-20.....	4 52	1.4	6.1	13.4	18.0	18.6	17.7	16.3	12.9	6.1	1.9	0.1	.....	.....	.....	.....	113	34	39	7						
21-31.....	5 01	1.9	8.4	17.5	24.1	25.8	24.5	23.9	13.7	7.8	2.0	.....	.....	.....	.....	146	41	40	7							
Feb. 1-10.....	5 12	0.2	3.3	10.2	17.4	23.4	26.8	25.9	20.9	17.3	10.7	3.0	0.3	.....	.....	159	41	38	7							
11-20.....	5 23	0.3	5.1	15.2	26.3	36.4	37.6	36.2	31.2	23.4	15.5	4.6	0.4	.....	.....	232	53	59	6							
21-28.....	5 34	0.6	8.3	22.2	29.8	42.0	47.8	31.2	45.8	32.6	19.4	6.8	0.7	.....	.....	307	61	78	4							

TABLE 3.—*Radiation extremes at Washington, D. C.*

[Gram-calories per square centimeter of horizontal surface.]

Decade.	Sun's mean zenith distance at noon.	Maximum.			Minimum.			Decade.	Sun's mean zenith distance at noon.	Maximum.			Minimum.			
		Per minute.	Per hour.	Per day.	Per day.					Per minute.	Per hour.	Per day.	per day.			
1909.	° '	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Mar. 1-10.....	1911.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
July 24-31.....	19 42	1.54	82.2	666	416	.....	.....	45 00	1.36	77.0	546	166	.....	.....	.....	.....
Aug. 1-10.....	22 01	1.55	80.6	599	413	.....	.....	41 06	1.60	87.4	642	45	.....	.....	.....	.....
11-20.....	24 57	1.52	81.4	636	412	.....	.....	38 51	1.58	86.7	642	320	.....	.....	.....	.....
21-31.....	28 26	1.41	80.3	641	280	.....	.....	32 53	1.55	90.3	690	54	.....	.....	.....	.....
Sept. 1-10.....	32 13	1.34	75.6	602	166	.....	.....	29 12	1.75	88.6	693	94	.....	.....	.....	.....
11-20.....	36 00	1.37	67.9	482	134	.....	.....	25 46	1.71	90.3	736	60	.....	.....	.....	.....
21-30.....	39 54	1.38	73.2	507	227	.....	.....	23 42	1.70	87.5	712	237	.....	.....	.....	.....
Oct. 1-10.....	43 46	1.25	64.4	441	118	.....	.....	20 05	1.55	81.7	675	552	.....	.....	.....	.....
11-20.....	47 32	1.14	59.7	402	104	.....	.....	17 49	1.60	85.8	740	416	.....	.....	.....	.....
21-31.....	51 17	1.05	60.4	390	71	.....	.....	16 23	1.62	90.8	774	112	.....	.....	.....	.....
Nov. 1-10.....	54 41	0.89	50.8	304	30	.....	.....	15 36	1.59	90.0	699	188	.....	.....	.....	.....
11-20.....	57 23	0.88	46.2	270	98	.....	.....	13 31	1.65	87.4	766	257	.....	.....	.....	.....
21-30.....	59 42	0.94	43.7	247	28	.....	.....	10 06	1.71	85.0	743	335	.....	.....	.....	.....
Dec. 1-10.....	61 18	0.78	43.7	245	27	.....	.....	7 22	1.56	85.4	618	329	.....	.....	.....	.....
11-20.....	62 10	0.73	35.9	187	19	.....	.....	19 20	1.62	87.8	722	331	.....	.....	.....	.....
21-31.....	62 17	0.88	48.8	278	39	.....	.....	21 53	1.66	86.6	693	285	.....	.....	.....	.....
1910.								24 48	1.70	84.2	679	336	.....	.....	.....	.....
Jan. 1-10.....	61 29	0.81	47.2	286	17	.....	.....	21 31	1.60	82.0	641	56	.....	.....	.....	.....
11-20.....	59 59	0.83	47.4	284	22	.....	.....	19 02	1.43	80.9	627	217	.....	.....	.....	.....
21-31.....	57 41	1.00	47.1	276	17	.....	.....	16 49	1.41	77.0	504	165	.....	.....	.....	.....
Feb. 1-10.....	54 46	1.01	59.5	354	25	.....	.....	13 42	1.33	73.4	536	239	.....	.....	.....	.....
11-20.....	51 31	1.14	62.8	381	53	.....	.....	10 24	1.34	81.7	485	73	.....	.....	.....	.....
21-28.....	48 18	1.22	60.0	463	108	.....	.....	7 22	1.27	71.0	491	107	.....	.....	.....	.....
Mar. 1-10.....	44 54	1.15	68.5	477	52	.....	.....	5 13	1.14	66.1	417	85	.....	.....	.....	.....
11-20.....	40 59	.....	.....	.....	.....	.....	.....	1 20	1.04	60.0	365	44	.....	.....	.....	.....
21-31.....	36 46	1.39	81.1	617	151	.....	.....	59 37	1.06	54.8	333	11	.....	.....	.....	.....
Apr. 1-10.....	32 48	1.39	81.1	617	151	.....	.....	32 02	1.43	80.9	327	217	.....	.....	.....	.....
11-20.....	29 06	1.45	81.7	649	55	.....	.....	35 49	1.41	77.0	504	165	.....	.....	.....	.....
21-30.....	25 41	1.69	84.9	670	198	.....	.....	39 42	1.33	73.4	536	239	.....	.....	.....	.....
May 1-10.....	22 38	1.57	88.9	749	208	.....	.....	43 34	1.31	72.1	485	73	.....	.....	.....	.....
11-20.....	20 02	1.68	91.8	752	140	.....	.....	47 22	1.27	71.0	491	107	.....	.....	.....	.....
21-31.....	17 47	1.77	87.5	726	318	.....	.....	51 13	1.14	66.1	417	85	.....	.....	.....	.....
June 1-10.....	16 22	1.58	86.1	752	58	.....	.....	61 32	1.05	56.9	358	51	.....	.....	.....	.....
11-20.....	15 36	1.64	76.4	580	184	.....	.....	60 04	0.83	42.6	217	84	.....	.....	.....	.....
21-30.....	15 31	1.55	85.5	711	451	.....	.....	57 48	1.04	54.2	343	41	.....	.....	.....	.....
July 1-10.....	16 08	1.51	87.1	710	224	.....	.....	54 55	1.12	63.6	379	185	.....	.....	.....	.....
11-20.....	17 24	1.51	86.9	657	168	.....	.....	51 41	1.06	61.9	417	65	.....	.....	.....	.....
21-31.....	19 23	1.42	85.6	736	462	.....	.....	48 18	1.29	71.2	491	107	.....	.....	.....	.....
Aug. 1-10.....	21 57	1.48	86.6	672	104	.....	.....	44 42	1.29	67.7	467	20	.....	.....	.....	.....
11-20.....	24 53	1.45	74.8	608	164	.....	.....	40 47	1.38	80.3	567	43	.....	.....	.....	.....
21-31.....	28 21	1.36	73.1	544	108	.....	.....	36 33	1.43	78.1	559	69	.....	.....	.....	.....
Sept. 1-10.....	32 07	1.29	72.3	536	114	.....	.....	32 36	1.46	77.8	542	118	.....	.....	.....	.....
11-20.....	35 55	1.29	73.1	550	164	.....	.....	28 55	1.42	77.8	570	59	.....	.....	.....	.....
21-30.....	39 47	1.23	65.2	474	198	.....	.....	1914.	.....	.....	.....	.....	.....	.....	.....	.....
Oct. 1-10.....	43 42	1.14	64.7	481	60	.....	.....	54 39	1.07	51.6	301	172	.....	.....	.....	.....
11-20.....	47 27	1.09	63.0	438	143	.....	.....	57 27	0.94	46.5	283	19	.....	.....	.....	.....
21-31.....	51 17	1.30	63.0	397	186	.....	.....	59 42	0.83	47.0	267	122	.....	.....	.....	.....
Nov. 1-10.....	54 36	1.27	60.2	376	72	.....	.....	61 18	0.84	33.8	145	20	.....	.....	.....	.....
11-20.....	57 24	1.13	56.9	346	93	.....	.....	62 11	0.90	46.3	260	34	.....	.....	.....	.....
21-30.....	59 40															

TABLE 4.—*Daily normals and departures of solar and sky radiation.*

[Gram-calories per square centimeter of horizontal surface.]

Month and day.	Daily normal.	Daily departures.					Total excess or deficiency since 1st of month.							
		Washington, D. C.			Mount Weather, Va.		Washington.	Washington, D. C.			Mount Weather, Va.		Washington.	
		1910	1911	1912	1913	1914		1910	1911	1912	1913	1914		
Jan. 1.	Gr.-cal.	164	*— 12	—135	— 8	66	30	41	— 12	—135	— 8	66	30	41
2.		164	— 63	—124	33	61	— 58	— 1	— 75	—259	25	127	— 28	40
3.		164	— 60	—133	— 91	—106	—152	53	—135	—392	— 66	21	—180	93
4.		164	— 83	* 108	18	79	—120	— 67	— 52	—284	— 48	100	—300	26
5.		164	—147	63	64	— 15	— 98	55	—199	—221	16	85	—398	81
6.		165	—111	122	61	— 17	100	— 73	—310	— 99	77	68	—308	8
7.		165	4	117	132	—119	— 67	72	—308	18	209	— 51	—365	80
8.		166	81	* 41	—115	—107	29	76	—225	59	94	—158	—336	186
9.		166	84	83	192	96	— 72	41	—141	142	286	— 62	—408	197
10.		167	119	173	166	— 12	34	59	— 22	315	452	— 74	—374	256
11.	167	22	— 35	— 31	— 18	34	87	0	280	421	— 92	—340	189	
12.		168	— 37	—127	— 84	—118	92	144	— 37	153	337	—210	—248	25
13.		168	— 111	— 98	*— 6	81	* 84	78	—143	55	331	—129	—184	101
14.		169	—147	— 37	†— 16	54	* 119	*— 86	—295	18	315	— 75	— 45	15
15.		170	99	— 77	†— 74	60	16	61	—196	— 59	241	— 15	— 29	76
16.		172	† 112	125	†— 1	— 74	— 79	48	— 84	66	240	— 89	—108	124
17.		174	— 79	— 77	* 43	— 24	— 71	—134	—163	— 11	283	—113	—179	— 10
18.		176	— 84	90	— 5	— 65	30	—144	—247	79	278	—178	—149	— 154
19.		178	38	116	11	65	— 42	—102	—209	195	289	—113	—101	— 258
20.		180	43	44	4	— 16	— 18	— 84	—166	230	293	—139	—209	— 340
Decade departure...									—144	— 76	—159	— 55	165	— 596
21.	182	—165	— 70	161	33	63	2	—331	169	454	— 96	—146	— 338	
22.		184	— 14	—143	113	96	— 39	— 08	—345	21	567	0	—185	— 406
23.		186	† 80	160	55	— 91	72	—125	—265	181	652	— 91	—113	— 531
24.		189	—108	150	49	—161	—110	—128	—373	331	701	—252	—223	— 650
25.		191	85	133	19	57	50	— 65	—288	464	720	—195	—173	— 724
26.		194	— 71	— 50	—140	87	93	65	—359	414	580	—108	— 80	— 659
27.		196	—148	34	4	—169	21	— 46	—507	448	584	—277	— 59	— 705
28.		198	—137	147	8	48	13	—128	—644	595	592	—229	— 46	— 833
29.		200	—110	—137	—159	—126	89	87	—754	458	433	—355	43	— 746
30.		203	*— 15	139	— 96	89	— 29	37	—769	597	337	—266	14	— 709
31.		205	—146	— 39	54	— 12	— 93	—156	—915	558	391	—278	— 79	— 865
Decade departure...								—749	319	98	—149	130	— 525	
Total excess or deficiency since first of year...								—915	558	391	—278	— 79	— 865	
Feb. 1.	208	* 92	—126	78	115	128	—180	92	—126	78	115	128	— 180	
2.		212	98	— 76	— 27	107	134	—163	190	—202	51	222	262	— 343
3.		216	—107	160	54	—184	— 4	—167	83	— 42	105	38	258	— 510
4.		220	118	30	150	— 49	95	42	201	— 3	264	87	333	— 468
5.		224	60	120	124	117	—132	—157	261	117	388	204	221	— 625
6.		228	† 42	—185	148	128	—204	— 75	303	— 68	536	332	17	— 700
7.		232	122	124	129	112	104	*— 156	425	56	665	444	121	— 856
8.		236	32	—203	108	— 14	139	— 1	449	—145	773	430	260	— 857
9.		240	*— 215	—163	93	53	165	94	232	—310	866	483	425	— 763
10.		244	— 100	163	134	54	—139	96	341	—147	1,000	537	286	— 667
11.		248	—195	157	136	—124	69	74	146	10	1,136	413	355	— 593
12.		252	30	172	— 57	103	95	—165	176	182	1,079	516	450	— 758
13.		256	24	† 66	161	123	—161	—154	200	248	1,240	639	289	— 912
14.		260	101	— 98	25	102	* 107	—141	301	150	1,265	741	396	— 1,063
15.		263	†— 62	—238	—198	90	* 141	—186	239	— 88	1,067	831	537	— 1,239
16.		267	55	— 106	— 26	—102	* 80	— 78	294	—194	1,041	729	617	— 1,317
17.		270	— 75	—148	†— 3	—119	* 6	5	219	—343	1,038	610	623	— 1,312
18.		274	104	—258	—206	104	—140	125	323	—600	832	714	483	— 1,187
19.		277	104	—114	36	52	—206	107	427	—714	868	766	277	— 1,080
20.		280	†— 70	—150	—144	—150	—152	89	357	—864	724	616	125	— 991
Decade departure...								16	—717	—276	79	—161	— 324	
21.		284	*— 176	144	—261	—120	193	75	181	—720	463	496	318	— 916
22.		287	15	170	95	—170	— 48	67	196	—550	558	326	270	— 849
23.		290	*— 11	† 214	167	61	—205	— 35	185	—336	725	387	65	— 884
24.		293	—113	† 79	— 44	— 9	224	—231	72	—257	681	378	289	— 1,115
25.		296	167	† 207	— 48	50	* 139	— 96	239	— 50	683	428	428	— 1,211
26.		299	* 63	† 198	—247	*— 69	185	128	302	148	388	359	613	— 1,083
27.		302	* 26	† 168	52	—227	113	50	328	316	438	132	726	— 1,033
28.		305	†— 174	†— 11	* 96	* 56	— 74	143	154	305	534	188	652	— 890
29.		306				— 34				500				
Decade departure...								—203	1,169	—224	—428	527	101	
Total excess or deficiency since first of year...								—761	863	891	— 90	573	— 1,755	

\* Partly estimated from sunshine record.

† Estimated from sunshine record.

TABLE 4.—*Daily normals and departures of solar and sky radiation—Continued.*

Month and day.	Daily normals.	Daily departures.						Total excess or deficiency since first of month.						
		Washington, D. C.			Mount Weather, Va.			Washington, D. C.			Mount Weather, Va.			
		1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1913	1914	
Mar. 1.....	Gr.-cal. 308	Gr.-cal. -191	Gr.-cal. † 45	Gr.-cal. * 117	Gr.-cal. -143	Gr.-cal. -165	Gr.-cal. -191	Gr.-cal. 45	Gr.-cal. 117	Gr.-cal. -143	Gr.-cal. -165	Gr.-cal. -143	Gr.-cal. -165	
2.....	310	-171	-1	61	130	-48	-362	44	178	-13	-213	-13	-213	
3.....	313	-112	172	-44	94	* 161	-474	216	134	81	-52	43	-52	
4.....	316	72	-150	-191	-144	95	-402	66	-57	-63	43	-202	-202	
5.....	318	21	228	54	105	-245	-381	294	-3	42	-202	-202	-202	
6.....	321	57	* -57	-195	67	-225	-324	237	-198	109	-427	-427	-427	
7.....	323	154	-142	61	156	87	-170	95	-137	265	-340	-340	-340	
8.....	325	69	17	-203	-21	59	-101	112	-340	244	-281	-281	-281	
9.....	328	18	211	-238	1	88	-83	323	-578	245	-193	-193	-193	
10.....	330	-278	154	137	-239	180	-361	477	-441	6	-13	-13	-13	
11.....	332		221	78	-57	-242		898	-365	-51	-255	-255	-255	
12.....	335		* 61	-292	42	243		759	-657	-9	-12	-12	-12	
13.....	337		-229	-84	-285	108		530	-741	-294	96	96	96	
14.....	339		-232	60	-218	94		298	-681	-512	190	190	190	
15.....	341		100	-294	-187	* 125		407	-975	-890	316	316	316	
16.....	343		299	49	-87	* 40		706	-926	-786	361	361	361	
17.....	345		191	222	186	65		897	-704	-800	426	426	426	
18.....	347		-214	95	175	-43		683	-809	-425	383	383	383	
19.....	350		-305	90	95	-93		378	-519	-330	291	291	291	
20.....	352		179	8	-7	29		557	-511	-337	320	320	320	
Decade departure.....								80	-70	-331	333	333	333	
21.....	354		233	* -255	-196	* 121		790	-768	-533	441	441	441	
22.....	356		74	11	166	57		864	-755	-367	498	498	498	
23.....	358		108	5	22	54		972	-750	-345	552	552	552	
24.....	360		* 283	-291	-96	* 178		1,254	-1,041	-441	730	730	730	
25.....	362		* 203	89	-166	149		1,456	-952	-807	879	879	879	
26.....	364		-19	166	-270	-31		1,437	-786	-577	848	848	848	
27.....	366		29	38	74	-5		1,466	-743	-803	843	843	843	
28.....	368		157	-83	201	* -120		1,623	-831	-602	723	723	723	
29.....	370		2	-50	-89	166	-266	2	1,573	-920	-436	457	457	457
30.....	372		-39	* 17	179	-62	-212	-37	1,590	-741	-498	245	245	245
31.....	374		3	98	185	70	11	-34	1,688	-556	-428	256	256	256
Decade departure.....								1,131	-45	-91	-64	-64	-64	
Total excess or deficiency since first of year.....								2,551	335	-518	829	829	829	
Apr. 1.....	376	37	* 107	33	136	-283	37	107	33	136	-283	-283	-283	
2.....	378	111	274	-194	-63	-257	148	381	-161	73	-540	-540	-540	
3.....	381	* -227	-321	36	98	-140	-79	60	-125	171	-680	-680	-680	
4.....	383	* -97	-329	159	-105	23	-176	-369	34	86	-657	-657	-657	
5.....	385	34	-202	96	248	* 71	-142	-561	130	314	-586	-586	-586	
6.....	388	-44	214	36	-27	206	-186	-347	168	287	-380	-380	-380	
7.....	390	-141	-215	-172	225	55	-327	-562	-6	512	-325	-325	-325	
8.....	393	234	-283	90	207	-343	-103	-845	84	719	-668	-668	-668	
9.....	396	-2	-20	139	54	143	-105	-865	223	773	-525	-525	-525	
10.....	398	197	292	-135	-116	245	92	-573	88	657	-280	-280	-280	
11.....	401	131	210	169	-335	77	213	-363	257	302	-203	-203	-203	
12.....	404	-246	89	132	-330	235	-33	-274	389	-28	39	39	39	
13.....	407	233	48	-197	-286	239	190	-229	192	-284	271	271	271	
14.....	410	239	-316	-207	-345	-53	429	-545	-15	-629	218	218	218	
15.....	413	129	-128	19	-301	-339	558	-673	4	-930	-121	-121	-121	
16.....	418	69	152	-104	-147	-353	627	-521	-100	-1,077	-479	-479	-479	
17.....	423	-368	33	* -364	* 238	* 85	259	-488	-464	-830	-394	-394	-394	
18.....	428	-31	* 265	-317	156	* 151	228	-223	-781	-683	-243	-243	-243	
19.....	433	-184	-281	-120	21	126	44	-504	-910	-662	-117	-117	-117	
20.....	438	-60	-159	-16	267	-327	-16	-663	-926	-395	-444	-444	-444	
Decade departure.....							-108	-90	-1,014	-1,052	-164	-164	-164	
21.....	443	-244	* 104	279	250	-260	-550			-116	-194	-194	-194	
22.....	448	222	-388	* 192	183	-38	-947			76	-11	-11	-11	
23.....	453	-24	-91	119	73	-62	-1,038			195	62	62	62	
24.....	458	-266	89	37	-17	-323	-949			283	45	45	45	
25.....	463	54	273	77	-383	-268	-676			369	-338	-338	-338	
26.....	468	149	232	-10	-86	-119	-444			359	-423	-423	-423	
27.....	473	-91	174	-377	158	-210	-270			-18	-265	-265	-265	
28.....	478	82	117	-102	122	-128	-153			-120	-143	-143	-143	
29.....	483	-103	146	* -191	-56	-231	-7			-311	-199	-199	-199	
30.....	488	133	-100	208	-109	-98	-107			-103	-368	-368	-368	
Decade departure.....							-82	556		292	76	76	76	
Total excess or deficiency since first of year.....							-859	2,444		-641	461	461	461	

\* Partly estimated from sunshine record.

† Estimated from sunshine record.

TABLE 4.—*Daily normals and departures of solar and sky radiation—Continued.*

Month and day.		Daily departures.						Total excess or deficiency since first of month.					
		Daily normals.	Washington, D. C.		Mount Weather, Va.			Washington, D. C.		Mount Weather, Va.			Gr.-cal.
			1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	
May	1	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
	2	494	71	-20	136	* 92	71	-20	131	131	136	92	264
	3	499	-119	151	128	217	-48	-120	210	210	264	309	309
	4	504	-72	79	111	* 54	-29	-115	241	241	375	383	383
	5	509	5	131	61	-29	-115	241	241	436	436	334	334
	6	514	192	176	59	-345	77	517	495	495	-11	-11	-47
	7	518	231	194	-82	* -36	308	711	232	232	413	413	47
	8	520	67	82	-181	48	375	793	399	399	-271	-271	1
	9	522	-224	-285	167	-272	151	508	151	151	399	399	-271
	10	524	-123	29	27	* 57	29	537	436	436	-214	-214	626
		526	131	132	200	-112	160	669	669	669	626	626	-326
	11	527	-387	148	202	35	-227	817	828	828	-291	-291	828
	12	529	-331	54	170	99	-558	871	998	998	-192	-192	998
	13	530	85	68	-24	-363	-473	939	974	974	-514	-514	974
	14	531	-7	129	-333	94	-480	1,008	641	641	-450	-450	641
	15	532	91	96	-145	68	-389	1,161	496	496	-382	-382	496
	16	532	89	34	-236	166	-300	1,198	260	260	-216	-216	260
	17	532	220	* 20	-162	-449	94	-80	218	-162	-189	-189	-122
	18	532	55	* 36	120	* -92	173	-25	1,254	-42	-281	-281	51
	19	532	208	71	97	130	151	183	1,375	55	-131	-131	202
	20	532	-182	129	123	-38	106	1	1,454	178	-169	-169	308
Decade departure...								-159	785		-795	-795	634
21		532	-118	67	105	-50	88	-117	1,521	283	-219	-219	396
22		532	13	137	107	-223	33	-104	1,658	300	-442	-442	420
23		532	* 83	125	-77	-457	80	-187	1,753	313	-899	-899	489
24		532	* 56	-117	77	-211	75	-131	1,668	390	-1,110	-1,110	567
25		532	214	181	-88	122	28	-345	1,847	302	-988	-988	596
26		531	* -75	* 62	192	52	77	-420	1,909	494	-936	-936	672
27		531	75	157	131	-420	-23	-345	2,066	625	-1,365	-1,365	649
28		531	195	209	-35	-339	-175	-150	2,275	590	-1,704	-1,704	474
29		530	111	180	-218	1	-28	-39	2,435	372	-1,703	-1,703	446
30		530	-152	154	44	-178	-60	-191	2,589	416	-1,881	-1,881	386
31		530	-39	-60	176	229	196	-230	2,529	592	-1,652	-1,652	532
Decade departure...								-231	1,075	414	-1,483	-1,483	274
Total excess or deficiency since first of year.								-1,089	4,973		-2,273	-2,273	1,043
June	1	530	-172	244	159	85	-142	-172	244	159	85	-142	-142
	2	529	113	* 186	* 61	203	187	-59	430	220	286	46	46
	3	529	-417	-50	100	38	158	-476	389	320	326	183	183
	4	529	223	45	-61	-116	-249	-253	425	259	310	-66	-66
	5	528	-470	-83	79	172	159	-723	342	338	382	93	93
	6	528	47	-416	-101	104	130	-676	-74	237	486	223	223
	7	527	88	-302	24	-177	112	-588	-376	261	309	335	335
	8	527	209	* -304	221	11	-17	-379	-680	482	320	318	318
	9	526	-344	188	148	260	-114	-723	-492	630	580	204	204
	10	525	-394	143	190	249	28	-1,117	-350	820	820	232	232
		525	-245	67	145	103	94	-1,362	-283	965	932	326	326
	11	524	-340	20	132	241	67	-1,702	-263	1,087	1,173	393	393
	12	524	-314	-130	4	168	187	-2,016	-303	1,101	1,341	580	580
	13	524	-141	-27	-299	122	-430	-2,157	-430	803	1,463	150	150
	14	523	-247	54	-432	101	-41	-2,404	-376	370	1,584	109	109
	15	523	* -100	24	-218	96	234	-2,504	-352	182	1,660	343	343
	16	523	8	-119	* -32	22	170	-2,496	-471	120	1,682	513	513
	17	523	-147	-334	-146	182	88	-2,643	-605	-26	1,864	601	601
	18	523	28	67	-330	* 118	-94	-2,615	-738	-356	1,982	507	507
	19	523	58	177	94	* 4	261	-2,557	-561	-262	1,986	768	768
	20	523	167	243	91	* -65	69	-2,390	-318	-171	1,921	837	837
Decade departure...								-1,440	-211	-1,082	1,157	536	536
21		523	188	195	24	-313	-307	-2,202	-123	-147	1,608	530	530
22		523	* 131	11	7	-452	-86	-2,071	-112	-140	1,156	444	444
23		523	* 75	39	68	-157	106	-1,996	-73	-72	990	550	550
24		523	77	-166	* -218	-201	-1	-1,919	-299	-200	798	549	549
25		524	172	-29	39	-285	-16	-1,747	-268	-329	513	533	533
26		524	-36	32	-282	8	-139	-1,783	-236	-611	521	394	394
27		524	-73	148	-236	-32	-68	-1,856	-88	-847	-489	326	326
28		524	109	225	109	11	71	-1,747	137	-738	500	397	397
29		524	117	236	-402	92	235	-1,030	373	-1,140	592	632	632
30		524						927	934	-878	-1,394	-136	
Total excess or deficiency since first of year.								-2,719	5,346		-1,681	1,675	

\* Partly estimated from sunshine record.

TABLE 4.—*Daily normals and departures of solar and sky radiation—Continued.*

Month and day.	Daily normals.	Daily departures.						Total excess or deficiency since first of month.					
		Washington, D. C.			Mount Weather, Va.			Washington, D. C.			Mount Weather, Va.		
		1909	1910	1911	1912	1913	1914	1909	1910	1911	1912	1913	1914
July 1..	524	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>
2..	525	44	107	-147	54	*-350		44	197	-147	54	51	-350
3..	525	-116	62	90	-3	*55		-72	298	57	51	-295	
4..	525	-301	-1	115	148	193		-373	58	190	-96		
5..	525	-134	88	24	87	-390		-507	346	82	286	-486	
6..	525	64	218	78	-61	-108		-443	544	160	225	-684	
7..	525	185	218	158	112	-178		-258	782	318	337	-862	
8..	524	48	-189	93	163	34		-403	662	406	458	-940	
9..	523	124	12	140	-273	47		-291	473	499	621	-906	
10..	522	114	90	-8	*37	46		-177	575	631	348	-559	
11..	522	*-21	8	54	81	134		-108	583	685	466	-679	
12..	521	-16	-102	140	-189	109		-214	391	825	277	-570	
13..	520	-20	98	11	155	-230		-234	489	836	432	-800	
14..	520	†74	-38	-74	-157	-341		-160	451	762	275	-1,041	
15..	519	29	25	-32	-194	-218		-131	476	730	51	-1,250	
16..	518	-71	16	-60	204	-13		-202	492	670	285	-1,272	
17..	517	-349	*-174	-34	-341	-25		-551	318	636	-56	-1,297	
18..	516	-301	29	-290	6	66		-882	347	337	-50	-1,231	
19..	514	-68	101	245	88	202		-920	448	582	38	-1,029	
20..	513	144	-48	-280	7	151		-776	400	322	45	-878	
Decade departure.								-599	-175	-309	-340	-65	
21..	511	†225	56	-149	89	103		-551	456	173	134	-775	
22..	510	181	204	91	89	125		-370	660	264	223	-650	
23..	508	22	202	134	-105	33		-348	862	298	118	-617	
24..	506	112	182	-7	-431	-40		-146	855	-33	78	-710	
25..	505	161	139	317	-52	161		-27	1,072	-55	239	-912	
26..	503	95	93	166	13	18		-66	1,238	-72	267	-1,023	
27..	501	3	-39	184	192	-8		-27	1,422	120	249	-593	
28..	499	125	144	168	*116	6		171	1,590	236	256	-930	
29..	497	60	57	114	*-111	-7		228	1,704	125	248	-830	
30..	495	-79	-30	-164	83	-101		198	1,540	208	147	-805	
31..	494	-49	192	82	-88	-57		390	1,422	120	90	-640	
Decade departure.								1,166	1,222	-202	45	238	
Total excess or deficiency since first of year.								-2,329	6,968		-1,591	1,035	
Aug. 1..	492	40	191	30	-144	24		40	191	39	-144	24	
2..	490	* 77	50	91	18	146		77	90	282	57	2	-132
3..	488	-75	117	-132	-67	47		74	2	207	130	-40	-58
4..	486	-4	-36	-83	157	8		0	171	67	117	57	-58
5..	484	-50	188	-99	146	97		-116	-52	359	-32	263	-174
6..	483	76	141	-10	-84	-229		-105	24	500	-42	179	-279
7..	479	84	113	* 167	19	-123		* 48	108	613	125	198	-231
8..	477	122	-373	45	-114	-05		23	230	240	170	84	-293
9..	474	20	99	104	-285	-178		-14	250	339	274	-201	-222
10..	472	76	-143	121	-71	-15		-100	326	196	306	-272	-486
11..	469	167	139	200	28	-190		-95	493	335	595	-244	-676
12..	467	-313	* 10	-131	-28	-319		-243	180	345	464	-272	-965
13..	464	-312	-88	-16	-144	*-293		159	-132	257	448	-416	-1,288
14..	462	-155	73	-117	-154	-174		6	-287	330	331	-570	-1,462
15..	459	-317	-232	-34	35	-35		51	-604	98	297	-535	-1,497
16..	456	-193	-125	185	20	88		67	-707	-27	482	-515	-1,409
17..	454	9	-290	-61	-60	-18		80	-785	317	421	-575	-1,427
18..	451	-138	-78	-7	12	-30		132	-926	-385	414	-563	-1,457
19..	449	89	-135	230	*-59	-111		66	-837	-530	644	-622	-1,588
20..	446	82	125	208	-60	-160		26	-755	-405	852	-682	-1,408
Decade departure.								-1,081	-601	457	-410	-922	249
21..	444	181	-132	194	-17	137		-115	-574	-537	1,046	-699	-1,271
22..	441	* 200	-17	200	55	-292		97	-374	-554	1,246	-644	-1,563
23..	439	178	105	101	5	75		88	-196	-440	1,347	-639	-1,488
24..	436	124	55	83	114	28		-61	-72	-394	1,330	-525	-1,460
25..	433	116	13	-41	15	174		-350	44	-381	1,389	-510	-1,286
26..	431	-27	-295	-62	14	64		-289	17	-676	1,327	-496	-1,222
27..	428	* 178	41	56	10	19		-282	195	-635	1,383	-486	-1,203
28..	426	31	-85	122	26	70		-317	226	-730	1,505	-490	-1,124
29..	423	* -143	-315	-42	-108	-236		21	83	-1,035	1,463	-508	-1,360
30..	421	189	-69	-343	109	84		149	272	-1,104	1,129	-450	-1,278
31..	418	59	-140	-362	-77	82		98	331	-1,244	758	-596	-1,194
Decade departure.								1,086	-839	-94	146	214	-970
Total excess or deficiency since first of year.								331	-3,573	7,726		-2,785	-8

\* Partly estimated from sunshine record.

† Estimated from sunshine record.

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TABLE 4.—*Daily normals and departures of solar and sky radiation—Continued.*

Month and day.	Daily departures.						Total excess or deficiency since first of month.						
	Daily normals.	Washington, D. C.			Mount Weather, Va.			Washington, D. C.			Mount Weather, Va.		
		1909	1910	1911	1912	1913	1914	1909	1910	1911	1912	1913	
Sept. 1	Gr.-cal. 416	Gr.-cal. 132	Gr.-cal. -302	Gr.-cal. 169	Gr.-cal. 38	Gr.-cal. 68	Gr.-cal. 88	Gr.-cal. 132	Gr.-cal. -302	Gr.-cal. 169	Gr.-cal. 38	Gr.-cal. 88	
2	413	159	-283	-214	-11	54	139	321	-585	383	27	123	227
3	411	-79	-224	37	-175	-133	-119	242	-809	420	-148	-21	108
4	408	-158	116	169	-158	4	75	84	-693	589	-306	-17	183
5	406	75	10	-16	36	48	149	159	-683	.73	-270	31	332
6	403	139	133	81	68	107	80	298	-550	654	-202	133	412
7	400	133	108	83	-15	-50	143	431	-442	737	-217	88	555
8	398	* 48	120	-181	137	-199	-89	479	-312	556	-90	-111	466
9	395	-128	-40	-146	* 120	186	32	351	-352	410	30	75	548
10	392	-228	106	63	83	160	206	125	-246	473	113	235	754
11	390	92	-222	-147	45	141	-296	217	-468	326	158	376	458
12	387	* -116	73	57	28	-98	-339	101	-395	383	184	278	119
13	384	-19	22	-03	-9	68	32	82	-373	299	175	346	151
14	382	-5	-8	176	14	* 67	116	77	-381	466	189	413	267
15	379	* -16	171	-214	-79	62	112	61	-210	292	110	475	379
16	376	-242	73	-80	41	-76	123	-181	-137	172	151	399	501
17	374	-55	65	190	81	-209	-89	-236	-272	362	232	190	413
18	371	92	83	-129	-95	-166	90	-144	11	233	137	24	502
19	368	42	-204	5	-238	-131	16	-102	-183	238	-101	518	
20	366	-119	6	69	* 120	-294	120	-221	-187	307	19	-401	638
Decade departure.....								-346	59	-166	-94	-636	-116
21	363	-29	-30	-124	101	-290	* 36	-250	-217	183	120	-691	674
22	360	-50	114	-15	* -245	72	91	-300	-103	168	-125	-619	765
23	358	6	-160	-33	-321	146	-7	-294	-263	135	-446	-473	758
24	355	* -128	-107	-59	-305	76	-170	-422	-370	76	-751	-397	588
25	352	* 155	47	67	-248	45	-105	-287	-323	143	-909	-352	483
26	350	101	122	73	-263	46	174	-186	-201	216	-1,282	-306	657
27	347	* -67	101	-71	-15	84	140	-233	-100	145	-1,277	-222	787
28	344	148	67	-32	119	129	191	-85	-33	113	-1,158	-102	988
29	342	117	113	-80	-137	-101	139	32	80	33	-1,295	-203	1,127
30	339	123	-41	197	141	-87	101	155	39	230	-1,154	-290	1,228
Decade departure.....								376	226	-77	-1,173	111	590
Total excess or deficiency since first of year.....								486	-3,534	7,956	.....	-3,075	1,220

Month and day.	Daily departures.						Total excess or deficiency since first of month.					
	Daily normals.	Washington, D. C.			Mount Weather, Va.			Washington, D. C.			Mount Weather, Va.	Washing- ton.
		1909	1910	1911	1912	1913	1909	1910	1911	1912	1913	1914
Oct. 1	Gr.-cal. 336	Gr.-cal. 105	Gr.-cal. 80	Gr.-cal. -204	Gr.-cal. 112	Gr.-cal. -55	Gr.-cal. 105	Gr.-cal. 90	Gr.-cal. -204	Gr.-cal. 112	Gr.-cal. -85	.....
2	334	26	147	-210	92	-89	131	227	-414	204	-174	.....
3	331	+213	76	-132	103	-100	-82	303	-546	307	-274	.....
4	328	10	45	48	73	135	-72	348	-498	380	-139	.....
5	326	11	37	159	51	100	-61	385	-339	431	-39	.....
6	323	* 64	40	149	* 127	31	3	425	-190	558	-8	.....
7	320	86	-206	-247	* 67	-258	89	219	-437	625	-268	.....
8	318	68	-258	140	81	-238	157	-39	-237	706	-504	.....
9	315	52	107	135	73	-176	209	68	-162	779	-680	.....
10	312	-53	139	-38	57	-156	158	207	-200	826	-836	.....
11	310	-206	128	19	46	-229	-50	335	-181	882	-1,065	.....
12	307	60	110	-13	8	* 52	10	445	-194	890	-1,013	.....
13	304	98	104	187	-74	95	108	549	-7	816	-918	.....
14	302	-101	95	54	-181	118	7	644	-47	635	-800	.....
15	299	33	55	-187	77	-16	40	689	-140	712	-816	.....
16	296	-82	58	-6	120	90	-42	757	-146	832	-726	.....
17	293	32	116	-186	56	-38	-10	873	-332	888	-765	.....
18	290	-114	107	86	18	-190	-134	982	-246	906	-955	.....
19	287	111	-144	-16	-80	-240	-13	938	-282	926	-1,195	.....
20	284	57	-100	-176	94	-166	44	738	-438	920	-1,361	.....
Decade departure.....							-112	531	-238	84	-525	.....
21	281	-79	-73	-155	71	-53	-35	665	-593	991	-1,414	.....
22	278	77	-16	-183	-237	97	42	649	-776	754	-1,317	.....
23	275	-64	104	99	-156	94	-22	758	-677	598	-1,222	.....
24	272	-201	45	132	-53	-254	-233	798	-545	545	-1,477	.....
25	269	121	-76	148	-97	-225	-102	792	-397	448	-1,702	.....
26	266	92	81	100	53	2	-10	803	-297	501	-1,700	.....
27	263	4	-77	72	101	64	-6	736	-225	602	-1,636	.....
28	260	-68	137	-112	50	-39	-74	863	-337	652	-1,675	.....
29	257	89	45	73	49	67	15	908	-264	701	-1,608	.....
30	255	3	140	51	27	7	18	1,048	-213	728	-1,601	.....
31	252	* 73	103	-56	24	-40	91	1,151	-289	752	-1,641	.....
Decade departure.....							47	413	169	-168	-280	.....
Total excess or deficiency since first of year.....							583	-2,383	7,687	.....	-4,716	.....

\* Partly estimated from sunshine record.

† Estimated from sunshine record.

TABLE 4.—*Daily normals and departures of solar and sky radiation—Continued.*

Month and day.	Daily normals.	Daily departures.						Total excess or deficiency since first of month.					
		Washington, D. C.			Mount Weather, Va.		Wash- ington.	Washington, D. C.			Mount Weather, Va.		Wash- ington.
		1909	1910	1911	1912	1913	1914	1909	1910	1911	1912	1913	1914
Nov. 1.....	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>	<i>Gr.-cal.</i>
2.....	249	55	177	-9	-162	93	51	55	77	-9	-162	93	51
3.....	246	33	*-114	63	20	56	50	58	-37	54	-142	149	101
4.....	244	36	-146	110	59	66	57	124	*-183	164	-83	215	158
5.....	241	52	-169	-75	49	31	41	176	-352	89	-34	246	199
6.....	238	43	12	26	49	100	57	219	-340	115	15	346	256
7.....	235	-100	101	-198	*-1	100	33	119	-239	-83	16	446	289
8.....	232	*-2	144	98	-197	61	19	117	-95	15	-131	507	308
9.....	230	*-2	62	-14	58	-104	-58	115	-33	1	-123	403	250
10.....	227	-187	98	-158	*-89	-102	63	-82	65	-155	-212	211	313
11.....	224	-70	-16	44	*-69	-107	70	-152	49	-111	-281	104	383
12.....	221	30	52	107	24	-2	1	-122	101	-4	-257	102	384
13.....	219	45	33	-175	29	73	45	-77	134	-179	-228	175	429
14.....	216	-13	-1	149	-47	-40	52	-90	133	-30	-275	135	481
15.....	213	-13	-18	-75	51	-149	-24	-102	115	-105	-224	-14	457
16.....	210	-112	-31	40	-116	-174	-191	-214	84	-65	-340	-188	206
17.....	208	-45	-15	45	74	-176	25	-259	69	80	-266	-304	291
18.....	206	-1	-24	14	-8	56	-21	-260	45	94	-274	-308	270
19.....	203	31	* 64	77	47	* 71	33	-229	109	171	-227	-237	303
20.....	201	-34	* 33	135	33	* 61	-77	-263	142	306	-194	-176	226
Decade departure.....	199	71	147	-1	-50	* 47	26	-192	289	305	-244	-129	252
Decade departure.....								-40	240	416	37	-233	-131
Total excess or deficiency since first of year.....								405	-2,056	8,046	.....	-5,245	334
Dec. 1.....	178	22	-20	139	5	-149	-55	22	-20	139	5	-149	-55
2.....	176	66	94	-2	-127	-27	-31	88	74	137	-122	-176	-86
3.....	175	40	108	-27	29	-66	-45	128	182	110	-93	-242	-131
4.....	173	1	-67	79	-127	35	-46	129	115	189	-220	-207	-177
5.....	172	37	-153	121	-131	51	-135	166	-38	310	-351	-156	-312
6.....	171	* 22	*-117	146	*-30	-18	-151	188	-155	466	-881	-174	-463
7.....	171	-144	77	* 111	-51	-37	-122	44	-78	567	-432	-261	-585
8.....	170	37	82	75	-22	90	-100	81	4	642	-454	171	-685
9.....	170	75	55	-18	86	83	-134	159	59	624	-368	-88	-819
10.....	169	42	-25	53	42	-81	-136	193	34	677	-826	-169	-955
11.....	169	-10	-48	74	-128	61	-135	188	-14	751	-454	-108	-1,090
12.....	168	-100	30	-12	79	85	-52	88	16	739	-375	-23	-1,142
13.....	168	*-149	109	-75	66	37	*-108	-61	125	664	-309	64	-1,250
14.....	167	-3	-22	-97	56	-4	*-1	-64	103	567	-253	60	-1,251
15.....	167	*-23	52	-123	* 57	79	93	-87	155	444	-196	139	-1,158
16.....	166	-54	98	-147	7	56	77	-141	253	297	-189	195	-1,081
17.....	166	13	92	-25	-95	12	64	-128	345	272	-284	207	-1,017
18.....	166	21	-58	-48	-95	37	42	-107	287	224	-379	244	-975
19.....	165	2	-27	91	12	57	-121	-105	260	315	-367	301	-1,096
20.....	165	-31	-14	33	63	45	61	-136	246	348	-304	346	-1,085
Decade departure.....								-334	212	-329	22	515	-80
21.....	165	69	54	-84	47	-2	-79	-67	300	264	-257	344	-1,114
22.....	165	37	86	-146	50	89	-32	-30	386	118	-207	433	-1,146
23.....	164	49	-78	-102	-1	-150	25	19	308	16	-208	283	-1,121
24.....	164	50	-93	-129	-14	21	-119	69	215	-113	-222	304	-1,240
25.....	164	-125	90	-75	70	-136	-100	-56	305	-188	-152	168	-1,340
26.....	164	90	-82	-148	51	-135	100	34	223	-336	-101	33	-1,240
27.....	164	-33	119	-62	-11	102	50	-4	342	-398	-112	135	-1,190
28.....	163	15	23	154	75	*-38	41	11	319	-244	-37	97	-1,149
29.....	163	-16	-24	114	17	46	-121	-5	286	-130	-20	143	-1,270
30.....	163	115	-38	-31	-107	57	47	110	257	-161	-137	200	-1,223
31.....	164	31	111	-127	-28	-21	-58	141	385	-288	-155	179	-1,281
Decade departure.....								277	122	-636	149	-167	-246
Total excess or deficiency since first of year.....								546	-1,688	7,758	.....	-5,066	-947

\* Partly estimated from sunshine record.

† Estimated from sunshine record.